

Predation and foraging in Venezuelan capuchin monkeys (*Cebus olivaceus*). L.E. MILLER, Department of Anthropology, University of California at San Diego, La Jolla, CA 92093.

Previous observations of Venezuelan capuchins have revealed a striking pattern of food intake that is dependent upon group size and season: Females living in larger groups maintain consistent intake throughout the year (~1800 cc/day), while those in smaller groups eat significantly more in the wet season (~2800 cc/day) and less in the dry season (~1100 cc/day). Past research has attributed this pattern to temporal fluctuations in food availability and the differential competitive ability of large and small groups: During the dry season, food is scarce and easily monopolized by larger groups; in the wet season, food is abundant and even smaller groups can find adequate feeding sites. The work presented here explores another important variable: the impact of predation on foraging decisions. It was predicted that, when resources were located in "risky" areas, only members of larger groups would exploit these foods and thus gain a significant feeding advantage. This model was tested with data from an ongoing study of several groups of wedge-capped capuchins (*Cebus olivaceus*) at the Hato Piñero Biological Reserve in central Venezuela. At this site, wet-season resources are located "safely" in the trees, and thus large and small groups all have access. In the dry season, however, important resources are found primarily on the ground. Ad lib data on alarm calls show that monkeys perceive the ground to be a "risky" area. It was hypothesized that small groups would avoid ground foraging and thus forfeit access to terrestrial resources. Focal animal samples demonstrate that members of larger groups (H_1) spent more time on the ground (12% vs. 4% of behavioral observations, $\chi^2=23.39$, $p<0.001$) and (H_2) found a greater proportion of food on the ground (17% vs. 8% of feeding observations, $\chi^2=23.39$, $p<0.001$) than did those in smaller groups. These findings indicate that (a) perceived predation risk plays a significant role in the pattern of food intake, and (b) predation may influence individual fitness not only directly but also by its impact upon foraging success.

Ontogeny of the Neandertal occipitomastoid region. N MINÜGH-PURVIS, Neurobiology & Anatomy, MCP-Hahnemann University, Philadelphia, Pennsylvania 19129 and M. SPEIRS, Sociology/Anthropology, Swarthmore College, Swarthmore, Pennsylvania 19081

The unique morphology of the Neandertal occipitomastoid region has been studied by several researchers, particularly Caspari whose elegant functional analysis of this complex has greatly increased our understanding of the changes characterizing occipitomastoid morphology through the European late Pleistocene. Nevertheless, the nature of the biological processes responsible for the evolution of this region late in the hominid fossil record remains poorly understood.

Yet even without knowledge of their heritability, occipitomastoid traits are often used in character analyses undertaken to construct taxonomic schemes of late Pleistocene hominid evolution. The present study was undertaken in an attempt to clarify whether the distinctive Neandertal occipitomastoid morphology is primarily genetic in nature, i.e. appropriate for inclusion in character analysis, or whether it more likely represents a response to functional/behavioral constraints during the course of individual growth and development.

Non-metric and metric data from 32 late Pleistocene immature specimens from Europe and western-central Asia, ranging in age at death from infancy to adolescence, were utilized to analyze patterns of ontogenetic change in the occipitomastoid region. Growth profiles for the late Pleistocene groups were compared with each other, with late Pleistocene adults, and with several recent modern human samples. In addition, this region was dissected in 50 adult male and female cadavers of European and African-American descent in order to document possible soft tissue correlates of modern human adult occipitomastoid variation. A model for the ontogeny of the occipital and nuchal planes in Neandertals, early Upper Paleolithic associated peoples, and in modern humans is proposed, which not only accounts for the morphological differences seen in the adults of these groups but which demonstrates developmental continuity in the evolution of this region from the Upper Pleistocene to today. While this model supports the notion that Neandertal occipitomastoid morphology is primarily a response to functional constraints, the neurological underpinnings of the behavioral patterns responsible for such constraints are almost certainly of a genetic nature.

Postcranial variation in early African *Homo*. MIREYA I. MAYOR, Doctoral Program in Anthropological Sciences, SUNY-Stony Brook, Stony Brook, NY 11794

The morphological variability of specimens attributed to *Homo habilis* has been considered to be extreme by many paleoanthropologists. Some interpret this variability as evidence for more than one species. Others claim this variability is indicative of a single highly variable, polymorphic species. The current study investigates the overall extent of size variation, sexual dimorphism, and the presence or absence, within the hypodigm, of subgroups characterized by varying limb size.

Using exact randomization methods and bootstrapping techniques, several related questions are addressed. First I assess whether it is possible to observe the fossil size range within samples of modern hominoids. Additionally, and moving beyond the minimum/maximum possibilities to *probabilities*, I estimate the likelihood of sampling such differences in extant hominoids. Fossil minimum/maximum size ranges are defined by subtrochanteric measurements of femoral specimens O.H. 62, KNM-ER 1472 and humeral measurements at the mid shaft of O.H. 62 and KNM-ER 739. For further contrast, specimens O.H. 20 (*P. boisei*) and KNM-ER 736 (*Australopithecus* or *Homo*) are also included. Modern reference samples include gorillas, common chimpanzees and several human groups (all of known sex).

The maximum observed size (sex) difference in the fossil humeri and femora is either rare or not observed in human and chimpanzee samples, and is unusual even in gorillas. These results could imply that multiple taxa exist within the fossil assemblage. If the fossils from Olduvai Gorge and Koobi Fora are instead assumed to be from one sexually dimorphic species, then several scenarios are possible. One could interpret this variation as meaning that they had a polytypic population as extreme as that created when modern African Americans and pygmy humans are combined, or accept that they had a degree of sexual dimorphism at least as extreme as that of the most dimorphic African ape, the gorilla. Furthermore, the present study brings into question whether gorillas comprise an appropriate group by which to gauge postcranial variation in early *Homo* as has been suggested for Australopithecines.

Insulin sensitivity and aging. B.D. MITCHELL, Department of Genetics, Southwest Foundation for Biomedical Research, San Antonio, TX 78245

Insulin plays a fundamental role in glucose homeostasis by stimulating the uptake of glucose into skeletal muscle and the inhibiting production of glucose by liver. Defects in insulin sensitivity are associated with increased risk of type 2 diabetes and cardiovascular disease. Loss of tissue sensitivity to insulin (i.e., insulin resistance) accompanies aging, although the dynamics of this relationship are unknown. Substantial evidence indicates that genetic factors contribute to variation in insulin sensitivity. In this paper I discuss the hypothesis that insulin sensitivity and glucose homeostasis influence the aging process in general and longevity in particular. The first source of evidence for this hypothesis comes from a well-studied animal model of aging, the nematode *C. elegans*. Several single gene mutations have been identified in this organism that are associated with significant lengthening of lifespan. Two of these mutations are in genes integrally involved in glucose metabolism, including one that occurs in an insulin receptor-like gene. Further evidence relating insulin sensitivity to increased longevity is derived from animal studies, which show consistent associations between caloric restriction and increased longevity. The mechanisms underlying this association are debatable, but some data suggest that the correlation may be mediated by changes in body composition and glucose metabolism. In humans, long-term studies of the effects of caloric restriction are lacking, although epidemiologic studies have clearly demonstrated that insulin resistance is a strong risk factor for common aging-related diseases, including type 2 diabetes and cardiovascular disease. Taken together, these observations support the hypothesis that genetic factors influencing insulin sensitivity contribute to risk of common aging-related diseases and perhaps ultimately to variation in longevity.

A hierarchical analysis of Y-chromosome specific variation in Australian Aboriginal people. R.J. MITCHELL, K. ROGAN, La Trobe University, Melbourne, Australia, R. VAN OORSCHOT, Victorian Forensic Science Centre, Melbourne, C. TYLER-SMITH, University of Oxford

In this study we scored 106 unrelated Aboriginal males for a number of Y-specific markers. The subjects were resident principally in the Northern Territory. The markers included the slow evolving, bi-allelic polymorphisms (YAP, M9, M4 & RPS4Y) as well as the more mutable microsatellites (DYS19, 390, 391, & 392). Scoring both types of Y marker permits a hierarchical form of analysis. This procedure entails sub-division of Y chromosomes into distinct lineage clusters (haplogroups) defined by the compound grouping of alleles of the rare event polymorphisms, followed by examining the level of diversity within each of these haplogroups by using the more variable microsatellite loci (haplotypes). Such analysis gives information about the demographic history of the haplogroups, while minimizing the effect of recurrent mutation in microsatellites.

All 106 chromosomes fell into one of 3 haplogroups: M9 = 54% (defined by presence of the G allele), RPS4Y = 43%, (defined by the presence of the T allele), or lacking any of the 4 polymorphisms scored, 3%. The YAP and M4 variants were absent. The frequency of the RPS4YT chromosome in Australian Aboriginals is the highest yet reported. 42 unique microsatellite haplotypes were detected and a network analysis demonstrated that these fell into two distinct clusters, clearly separated by a much looser grouping of haplotypes. Each cluster contained several haplotypes. There was no evidence of reduced diversity for these markers compared to other world populations.

Addition of the haplogroups to the microsatellite network clarified the relationships among Australian Y chromosomes. The RPS4YT chromosome is present in all males in one of the clusters, and this cluster also contains the rare DYS390 'short' alleles (18-20 repeats) but it is absent in the other cluster, in which all belong to M9 haplogroup. The RPS4Y T allele is associated with other haplotypes in the network, but these have normal (22-26 repeats) DYS390 alleles. This suggests that the RPS4Y haplogroup is represented by at least two lineages in indigenous Australians.

Enamel hypoplasia in South African early hominids: A reappraisal. J. MOGGI-CECCHI, Palaeo-Anthropology Research Group, University of the Witwatersrand, Johannesburg.

Few studies are available in the literature on the occurrence of dental enamel developmental defects in early fossil hominids. Apart from isolated observations (Robinson, 1952, 1956; Tobias 1967, 1974) the most detailed analysis was carried out by White (1978) on South African Australopithecinae. In his study, he found a different occurrence of enamel hypoplasia in *Australopithecus africanus* and *A. robustus*, with the latter showing a higher prevalence of defects as compared to the former. He interpreted this difference as possibly due to a differential accumulation at the SK site of individuals with lower fitness preyed upon by

large carnivores. This would have not been the case at the site of Sterkfontein.

Since 1978 additional work at the site of Swartkrans and Sterkfontein has resulted in a marked increase in the number of teeth recovered, thus allowing a test of White's hypothesis (1978) on the basis of a much larger sample. A total of 259 permanent teeth from Swartkrans and 284 teeth from Sterkfontein have been analyzed. Teeth with more than half of the crown height missing due to wear were excluded from the analysis.

The results indicate that there is no difference between *A. africanus* and *A. robustus* in terms of the total number of teeth affected by enamel hypoplasia, both for the maxillary and the mandibular teeth. First molars of *A. africanus* generally lack enamel defects, whereas *A. robustus* shows 34.6 % of maxillary M1 and 20.8 % of mandibular M1 affected by enamel hypoplasia, confirming a previous observation by White (1978). Anterior teeth are more affected in *A. africanus* than in *A. robustus*, although this difference is not statistically significant.

It is suggested that this condition can possibly be explained by the combined evidence of the different timing of dental development of the two species, as reported by several authors, possibly associated with metabolic disruptions at weaning age.

Y chromosome diversity in modern Sudan.
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Few other countries exhibit the degree of cultural and linguistic diversity seen in Sudan. Moreover, the anthropological and archaeological record of this vast Northeast African country covers nearly all of the earlier history of modern humans: from Singa, one of the earliest anatomically modern human fossils found in Africa, through to numerous Neolithic archaeological sites which document the cultural evolution of Nile Valley populations, culminating in a Nubian dynastic empire to rival those of Egypt and Ethiopia. However, the many and complex human migrations from the Neolithic onwards, and thus the origins of many of the modern human populations in Sudan, remain poorly understood.

Previous genetic studies of modern Sudanese populations have concentrated on blood or mtDNA genetic markers. In this study, Y chromosome polymorphic markers were typed in about 300 modern Sudanese DNA samples, from individuals representing populations in the north and the south of that country. These markers are comprised of both microsatellites and binary polymorphisms, which have different mutation rates and thus provide a broader perspective of the populations of interest. Results from this analysis show striking differences in the frequency and distribution of haplotypes between northern and southern Sudanese

populations. These results will be discussed within the broader context of biological continuity in the Nile Valley.

A re-analysis of the lower molar morphology in *Callicebus* species groups: Implications for feeding adaptations. W.D. MOORE. Department of Anthropology and Center for Systematic Biology, Southern Illinois University, Carbondale, IL, 62901.

The current evidence available to strongly corroborate delineations between molar morphology and feeding behavior for the majority of the *Callicebus* species groups is limited and controversial. Behavioral data for *C. torquatus* suggests that insectivory makes up approximately 20% of the diet. Conversely, *C. moloch* has been observed to have a folivorous dietary component of almost 30%. Kinzey (1978, 1981) suggested that the molar morphology of these species differed according to each species 'secondary specializations for the breakdown of dietary protein'. Kinzey noted that in *C. torquatus*, the talonid basin and the molar size are relatively larger than in *C. moloch* whereas the shearing blade of the cristid obliqua and its angle relative to the plane between hypoconid and entoconid and where the cristid obliqua meets the protocristid are greater in *C. moloch* than in *C. torquatus*. These two morphologies can be related to secondary specializations for insectivory and folivory respectively.

Others (eg. Milton & Nessimian, 1984; Wright, 1985; Hershkovitz, 1990) have challenged these observations on the basis that there is too much interspecific variation present in these lower M1-2 characters and that secondary dietary specializations may only be seasonal for these taxa. Qualitative characters and measurements based on Kinzey's original criteria were made for lower right M1-2 for all *Callicebus* species in the so-called '*moloch*' and '*torquatus*' groups. Results suggest that there is a large amount of intra and interspecific variation in relative molar size, talonid size, and size and angle of the cristid obliqua in each of the species groups and refutes the position that certain aspects of lower M1-2 morphology can accurately predict or reflect the 'secondary specializations for the breakdown of dietary protein' in this primarily frugivorous platyrrhine.

Another look at Neandertal limb proportions. W.L. MOORE, Department of Anthropology, University of Tennessee, Knoxville, TN 37996.

Holliday (1995, 1997) states that European Neandertals are "hyperpolar" in body shape due to 1) cold

adaptation and 2) less effective cultural buffering of extreme cold stress. He suggests that intense selection pressure results in lower brachial and crural indices compared to modern human groups and concludes, as a result, that Neandertals were unlikely to be ancestral to modern humans.

The purpose of this study is to test the hypotheses proposed above. The sample consists of white males from the WWII dead (N=545) and European male Neandertals (N=3), which includes La Chapelle, La Ferrassie and Spy I. Maximum lengths of humerus, radius, femur and tibia are used. Size and shape variables are calculated using the Darroch and Mosimann (1985) method. Regression equations are derived from the WWII sample based on Neandertal element availability for direct comparison. For example the regression equation for La Chapelle size = $(\ln \text{humerus} + \ln \text{radius} + \ln \text{femur} + \ln \text{tibia})/4$. Bivariate plots of log transformed variables against size and shape variables are examined as well.

The results of the regression analysis do not support the conclusion that European Neandertals had relatively shortened distal limbs. Plots of log tibia against log femur lengths of the combined modern and Neandertal samples reveal that La Chapelle, La Ferrassie and Spy I not only are within the 95% confidence interval but in fact fall very close to the modern human regression line itself. These results suggest, in contrast to the studies cited above, that Neandertals are allometrically scaled as though they were modern humans.

Finally, the results of this study cannot support the hypothesis that European Neandertals had a "hyperpolar" adaptation nor are these data amenable with the contention that Neandertals were specifically distinct from modern humans.

Molecular phylogeny of the Colobines.

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We examine the phylogenetic relationships of the different genera of living colobines, with special emphasis on the Asian forms. Napier and Napier (1967) recognize five genera of Asian Colobines: *Presbytis*, *Rhinopithecus*, *Pygathrix*, *Nasalis*, and *Simias*. Groves (1989) recognizes the genera *Nasalis*, *Pygathrix*, *Presbytis*, *Trachypithecus*, and *Semnopithecus*; Oates et al. (1994) follow this arrangement but separate *Simias* as a different genus from *Nasalis*. Delson (1994) proposes an unresolved trichotomy between *Pygathrix*, *Nasalis* (including *Simias*), and a clade containing *Semnopithecus* (including *Trachypithecus*) and *Presbytis*. Jablonski (1998) presents a phylogeny of colobines in which the snub-nosed monkeys are monophyletic, with

Nasalis as sister taxon to *Pygathrix*, but with otherwise very little agreement with other proposed phylogenies.

Few molecular studies exist of the relationships among the leaf monkeys, usually with very few taxa, and consequently, they do not provide much resolution. In this study we focus on the phylogenetic relationships of most of the different colobine genera based on the ND3, ND4L, and ND4 mitochondrial DNA genes. Among our findings: *Procolobus* seems to be quite distinct from the rest of the African colobines; the Asian colobines form a monophyletic assemblage; *Semnopithecus entellus* seems to be the sister taxon to all the other Asian forms; the proboscis monkey is sister taxon to the snub-nosed monkeys, which in turn are sister taxa to a clade of the genera *Presbytis* and *Trachypithecus*. This research was supported by NSF grant 9707883.

The deciduous dentition of *Griphopithecus*: morphometric analyses of a Middle Miocene hominoid. G., MORTZOU, Department of Anthropology, UCL, Gower Street, London WC1E 6BT, P., J., ANDREWS, Department of Palaeontology, Natural History Museum, Cromwell Rd., South Kensington, London, SW7 5BD, L., C., AIELLO, Department of Anthropology, UCL, Gower Street, WC1E 6BT.

Seventy-four elements of hominoid primary dentition have been recovered from the Middle Miocene site of Pañalar, Turkey, comprising the largest corpus of reference material for fossil apes. Morphological structures that characterise the *G. alpani* permanent teeth from the site have been also identified in their deciduous predecessors. Contrary to the situation in permanent teeth, it is not possible to recognise two species on the basis of these characters in the primary dentition. A partial reconstruction of the age profile of the non-adult hominoid group is facilitated by the considerable size of the assemblage and is based on the degree of wear recorded on the dp4s plus eruption data for *P. troglodytes*. The analysis indicates underrepresentation of the very young individuals in the sample and high mortality for individuals belonging to the ca. 3-5 years age cohort, a situation that could be related to effects of stress resulting from weaning. The CV and the range index values obtained for the majority of tooth types are higher than the comparable values in a sample of *P. troglodytes*. The combined employment of both statistics considerably limits the susceptibility of these results to type 1 and 2 errors. Though not conclusive, the results are not inconsistent with the two-species hypothesis. Finally, these results together with comparable data from similar assemblages offer the possibility for general hominoid dental trends to be recognised and the phylogenetic polarity of certain characters to be evaluated.

The newly recovered Poloyo hominin (PL-1) from Java. **K. Mowbray**^{1,2}, **S. Márquez**³, **S.C. Antón**⁴, **C.C. Swisher III**⁵, **T. Jacob**⁶, **G. J. Sawyer**¹, **D. Broadfield**³, **J.T. Laitman**³, **R.L. Holloway**⁷, **E. Delson**^{1,8}, and **I. Tattersall**¹.
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In recent months, a fossil hominin calvaria (PL-1) lacking most of its basicranium and face turned up at a natural history curio shop in New York City. Prior to its return to Gadjah Mada University, Indonesia, we obtained CT images and made detailed comparisons with other Asian and African hominins. At this time, we report on the affinities of the newly recovered fossil human and discuss its possible geologic age.

The calvaria was obtained near Poloyo, Java, which neighbors Sambungmacan along the Solo River some 50-km north of the Sangiran Dome. Associated sediments extracted from PL-1 suggest that it may be of relatively young age for *Homo erectus*, perhaps contemporaneous with Ngandong and Sambungmacan. Cranial features that include frontal breadth and postorbital constriction, conformation of the mastoid, supramastoid crests, and the occipital torus suggest affinities to the geologically younger Ngandong specimens, but its estimated cranial capacity of 900 ml is more reminiscent of some of the Sangiran hominins. Importantly, PL-1 exhibits traits that are not typically seen in Javanese *H. erectus* specimens. These include a high vertical forehead that rises quickly from the midline, a somewhat greater cranial breadth relative to its length, and a non-barlike supraorbital torus that is midsagittally deficient. Preliminary comparative analyses on the arcs and chords of both the frontal and occipital with other adult *H. erectus* (n=20) and modern humans (n=281) show that PL-1 falls within the range of *H. erectus*. The combination of traits exhibited by PL-1 may serve to bridge the geologically older and younger Javanese *H. erectus* fossil specimens previously thought to be morphologically distinct. Yet, the unexpected combination of Ngandong-like characters with the relatively small brain exhibited by PL-1 may ultimately represent a morphologically distinguishable Ngandong/Poloyo population.

Impact of seasonal breeding on the life-history changes of morphological and hormonal parameters in two species of macaques. **M. MUEHLENBEIN**, **M. MURCHISON**, **S. FALKENSTEIN**, Vet. Sciences, Tulane Regional Primate Research Center. **B. CAMPBELL**, Department of Anthropology Boston University, Boston MA 02215

To assess the impact of seasonal breeding on testicular volume and related morphometric and hormonal parameters, two phylogenetically-related species with differing breeding seasonality were compared.

Subjects were 66 Indian-origin rhesus macaque males and 43 pigtailed macaques, ages 3 to 14, maintained at Tulane Primate Center. Morphological measurements included testicular volume, tricep circumference, tricep, subscapular,

and periumbilical skinfolds, weight, and occipital bunoisheal callosity length. Solid-phase radioimmunoassay (RIA) was used to determine levels of testosterone (T), estradiol, and dehydroepiandrosterone-sulfate (DHEAS).

Despite similar length and weight, testicular volume (3.04 ± 1.7 vs. 1.72 ± 1.3 cc), abdominal skinfold measures (15.9 ± 9.5 vs. 9.0 ± 7.7 mm), and DHEAS levels (16.1 ± 8.4 vs. 7.6 ± 5.5 ug/dl) were substantially greater in rhesus than pigtailed. T levels did not show a substantial difference between the two species (4.63 ± 3.2 vs. 3.53 ; $p = .08$). For both species, testicular volume, T, and estradiol increased, while DHEAS decreased, with age. Multivariate procedures indicated that for the rhesus, T levels were related to testes volume, estradiol to arm circumference, and DHEAS to abdominal fat (short-term storage). For the pigtailed, T levels were related to testes volume and DHEAS to subscapular fat (long-term storage). Significant interaction effects for species by age group for weight, tricep circumference, length, and estradiol level, indicated different developmental patterns and hormonal-morphometric associations between the two species.

It is argued that rhesus have larger testes for body size and more abdominal fat deposits relative to pigtailed because the rhesus are seasonal breeders. Hormonal patterns associated with these differences appear to be primarily related to adrenal rather than testicular activity.

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Differences in osteon organization between human and nonhuman bone. **D.M. Mulhern** and **D.H. Ubelaker**, Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington D.C. 20560

The presence of microscopic differences between human and nonhuman bone has been reported in the skeletal biology literature. For example, plexiform bone is more commonly found in nonhuman bone than in human bone. Also, a more linear organization of Haversian systems has been reported in nonhuman bone. Quantitative studies comparing microscopic differences between human and nonhuman bone are now necessary for establishing reference data that could be used to help distinguish human bone from nonhuman bone. The purpose of this study is to evaluate microscopic pattern differences between nonhuman and human bone.

The sample for this study consists of femoral midshaft sections from 60 subadult and adult humans (remains recovered from urban cemeteries in Santo Domingo, Dominican Republic), 9 subadult sheep and 6 miniature swine. The entire section was observed for each specimen at 40x and 100x using a standard compound light microscope. The presence of plexiform, lamellar or Haversian bone was recorded, in addition to the presence or absence of organized osteon bands. An osteon band was arbitrarily defined as a distinct row of 5 or more primary and/or secondary osteons. In a follow-up analysis, the presence of osteon bands was recorded for 73 other subadult long bones from the same human sample, since patterns are more likely to be observed in young bone without extensive secondary remodeling.

Results show that the nonhuman bone is characterized by mostly plexiform bone, with limited, more linearly organized Haversian systems. The human bone is characterized by lamellar bone interrupted by primary canals and randomly

distributed Haversian systems. Osteon banding is exhibited in femoral sections of 2 humans, 4 swine and 1 sheep. The presence of banding is significantly different between human and nonhuman femora ($X^2 = 9.46$; $p < 0.01$). One additional osteon band was present in one fibula out of 73 human subadult long bones from the follow-up study.

The type of osteon banding differs in the human and nonhuman samples. Short, isolated bands (5-6 primary or secondary osteons in a row) characterize the human samples, but multiple, long bands (5-20 mostly primary osteons) typify the nonhuman samples. Results indicate that the human and nonhuman bone in this study are readily distinguished.

Evolution and origin of primate social organization. A reconstruction. A.E. MÜLLER and U. THALMANN, Anthropological Institute, University of Zürich, CH-8057 Zürich, Switzerland.

The evolution and origin of primate social organization has attracted the attention of many researchers, and a solitary pattern, believed to be present in most nocturnal prosimians, has been generally considered as the most primitive system. Nocturnal prosimians are in fact mostly seen alone during their nightly activities, but that does not mean that they are not social. In fact, it has emerged over the last decades that all of them exhibit some kind of social network and that those networks differ among species. Cheirogaleids, bushbabies and lorises have generally been believed to exhibit a dispersed harem system as their pattern of social organization, and because they are thought to approach the ancestral primate condition most closely, the ancestral pattern of primate social organization was inferred to be a dispersed harem. In fact, new field data on cheirogaleids combined with a review of patterns of social organization in strepsirrhines revealed that they exhibit either dispersed multi-male systems or dispersed monogamy rather than a dispersed harem system. Therefore, the concept of a dispersed harem system as the ancestral condition of primate social organization can no longer be supported. In combination with data on social organization patterns in "primitive" placentals and marsupials, and in monotremes, it is in fact most probable that promiscuity is the ancestral pattern for mammalian social organization. Subsequently, a dispersed multi-male system derived from promiscuity should be regarded as the ancestral condition for primates. We further suggest that the gregarious patterns of social organization in *Aotus* and *Avahi*, and the dispersed form in *Tarsius* evolved from the gregarious patterns of diurnal primates rather than from the dispersed nocturnal type. It is consequently proposed that, in addition to *Aotus* and *Tarsius*, *Avahi* is also secondarily nocturnal.

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Analysis of sex differences in antemortem fracture rates among the Highland Park Skeletal Collection, Rochester, New York, with special consideration of interpersonal violence. J.L. MULLER, Anthropology, SUNY at Buffalo, NY 14261.

In 1984, a salvage excavation at Highland Park, Rochester, NY, led to the recovery of human skeletal remains. Based on county documentation of the site, it was determined that the remains belonged to a burial site utilized by the county poorhouse, which interred inmates between 1826 and 1863. This population was studied to determine the proximate and ultimate causes of fracture within the population and to each individual. This research is part of a larger effort to determine the quality of life for this 19th century population.

Of the 305 individuals excavated, 165 adult skeletons (100 male, 65 female) were examined. Focusing on fractures related to interpersonal violence, analysis was limited to the crania, clavicles, upper limbs, and ribs. Fracture trauma was determined macroscopically by evidence of healing and/or subsequent complications. The causes of fracture were determined in three steps (Lovell, 1997). 1) Presence and type of fracture were determined for each bone. 2) The mechanism leading to fracture was interpreted through fracture location and evidence of healing. 3) The characteristics leading to fracture and the skeletal pattern of trauma in the individual and the population were considered. By providing information on morbidity and mortality, historical documents added to the evaluation of the possible circumstances leading to fracture (i.e. prevalence of alcoholism).

Approximately 20% of the individuals show bone fractures. The majority of fractures are to the upper limbs and clavicle. The characteristics of the fractures, and the pattern of trauma within the population suggest that the majority of Highland Park fractures are the result of accidents. However, this does not negate the possibility that individual fractures may be due to interpersonal violence.

Evidence for violence-related trauma among Iron Age semi-nomadic populations from South Siberia. E.M. MURPHY, Lagan Archaeological Research, 24 Lille Park, Finaghy, Belfast, Northern Ireland, BT10 0LR.

The cemetery complex of Aymyrlug is situated in the Ulug-Khemski region of the Autonomous Republic of Tuva in south Siberia. Approximately 800 individuals of Scythian period date (c. 7th - 2nd century BC) and 200 burials dating to the Hunno-Sarmatian period (c. 1st century BC - 2nd century AD) were excavated by Russian archaeologists

between 1968 and 1984. The historical and archaeological evidence indicates that these societies were involved in high levels of conflict which was probably caused by the nature of their semi-nomadic lifestyle.

A wide variety of traumatic lesions and injuries were observed among individuals of all ages and both sexes in the Aymyrylg population groups during a recent palaeopathological analysis of their skeletal remains. Fractures characteristic of interpersonal violence were evident, as were injuries which had been caused by battle axes, arrowheads and swords. Evidence for decapitation, brain extraction and throat cutting was also observed and some of the earliest examples of Old World scalping were identified.

The objective of the paper is to present evidence for the different traumatic injuries apparent among the remains of the individuals, while also identifying the weapons responsible for causing each class of injury. In addition, the information contained in classical texts pertaining to warfare practices among these societies will be discussed.

A new skeleton of the large hominoid from Nachola, northern Kenya. M. NAKATSUKASA¹, Y. KUNIMATSU², Y. NAKANO³ and H. ISHIDA¹,
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A partial skeleton of a middle Miocene hominoid, which has provisionally been assigned to *Kenyanthropus* sp., was discovered from Nachola, northern Kenya (KNM-BG 35250) in the 1996-97 and 1997 field seasons. While this skeleton displayed some postcranial features similar to those found in *Kenyanthropus africanus* and *K. wickeri* from western Kenya, such as the developed lateral wall of the olecranon fossa (Nakatsukasa et al., 1998), many differences are observed in newly discovered postcranial elements. For example, the medial epicondyle is longer and less retroflexed, and the humeral capitulum is proximodistally large and more rounded than in the *K. wickeri* humerus (KNM-FT 2751).

Furthermore, the Nachola specimen exhibits unique body proportions among Miocene hominoids from East Africa. Compared with the hindlimb, the forelimb is strikingly large and robust. The distal humerus, proximal ulna and distal radius are as large as those of female chimpanzees whereas most of the long bones of the hindlimb and the tarsals are close to those of a small-sized baboon in articular size. The clavicle is slender and much longer than that of a large colobine monkey, though shorter than that of chimpanzees. In addition to these forelimb characteristics, the lengths of the associated hallux and lateral digit (presumably the third) are comparable to those of male chimpanzees. These features suggest that the Nachola hominoid was quite

specialized for forelimb dominated arboreal positional behavior, probably including orthograde climbing and postures on vertical support. In this regard, the Nachola hominoid differs from the early Miocene *Proconsul*, a generalized arboreal quadruped, and *K. africanus* and *K. wickeri*, which are argued to be characterized by macaque-like digitigrade terrestrial quadrupedalism.

Preliminary observations on *Galago moholi* and *Otolemur crassicaudatus* in Makapansgat Valley, South Africa. L. T. NASH and K. WEISENSEEL, Anthropology, Arizona State University, Tempe, AZ 85287-2402.

Previous studies of galagos in South Africa have not concentrated on species interactions in sympatry. Indeed, areas of sympatry between *Galago moholi* (GM) and *Otolemur crassicaudatus* (OC) are relatively rare. Makapansgat Valley, near the site of the famous australopithecine discoveries, is an area of dramatic vegetation change. Within a distance of about 2 km along the valley, the vegetation changes from *Acacia* woodland to a small patch of relic forest. The two sides of the valley, one facing mainly south and the other north, also show substantially different vegetation due to differences in solar exposure and soils. During the austral winter (June-July, 1999), we made censuses of GM and OC, tested trapping methods on both species and successfully trapped both, and radio-tracked one adult male OC. During these cold months, when little fruit was available, both species were seen to eat *Acacia* gum and GM foraged for insects. Both species were encountered at similar rates along the vegetation gradient within the valley. However, GM were encountered about three times as often as OC. The tracked male OC used 11 different sleeping sites within 25 days of observation. His range was large relative to reports in the literature. Future studies will examine how these species differentially use the vegetation gradient and whether they become more different in their habitat use in seasons when more fruit is available.

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Activity Budget and Habitat Use of the Slender Loris (*Loris tardigradus lydekkerianus*) in Dindigul District, Tamil Nadu, India. K.A. I. NEKARIS. Department of Anthropology, Washington University, St. Louis, MO 63130.

From October 1997 to August 1998, I conducted a study of the socioecology of the slender loris (*Loris tardigradus lydekkerianus*) in a dry scrub jungle of Tamil Nadu, India. During 1173 hours of observation, the following variables were recorded every five minutes: behavior, position, tree species used, height of tree, height of animal in tree, type of support, orientation of support, and sex and age of individual. In addition, the same variables were recorded at the moment of contact, yielding 357 records. The main

study population was composed of 15 animals, including five adult females, four adult males, one juvenile female, two juvenile males, two female infants, and one male infant. These animals were observed throughout the night or for as long as possible ($x=6.2$ hours per follow).

Activity budgets were compiled in three ways: all data pooled ($n=13717$), the average of means of different individuals ($n=15$), and by contact data ($n=357$). Presented here are the means and standard deviations of the average of these three data sets. Lorises engaged in the following activities: inactive (0.41 ± 0.04); forage (0.27 ± 0.04); shift (0.09 ± 0.05); travel (0.15 ± 0.09); groom (0.04 ± 0.02); other (0.01 ± 0.006). Lorises spent 79% of their time alone (±0.02) and 21% of their time interacting with other lorises (±0.02). Of 11 different positions recorded (based on an ethogram by Schulze and Meier 1997), the top three were: sit (0.29 ± 0.01); quadrupedal walk (0.25 ± 0.06); and bridge (0.08 ± 0.02).

The mean height of trees used by lorises at the study site was 5.6 m (±0.05), and the mean height of an animal in a tree was 3.4 m (±0.06). The three most commonly used trees were *Acacia ferruginea* (0.24 ± 0.03), cactus (0.17 ± 0.05), and *Azadirachta indica* (0.18 ± 0.01). Lorises most often used small substrates (0.58 ± 0.08) with oblique orientations (0.63 ± 0.1) with other types used less than 20% of the time each.

This project was supported by grants from One With Nature of the Philadelphia Zoo, Sophie Danforth Conservation Biology Fund, Primate Conservation Inc., Wenner-Gren Foundation, and NSF (SBR-9714870).

Ontogeny of Limb Robusticity in the Upper Pleistocene of Europe

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We (Thompson & Nelson 1998) recently demonstrated that the distinctive limb robusticity (cross-section of shaft to length) and proportions (inter and intra-limb) demonstrated by European Neandertals were the product of an ontogenetic trajectory that tracked with cold adapted rather than warm adapted modern humans. A cautionary conclusion offered in that paper was that any analyses of Neandertal juveniles must be undertaken with reference to climate appropriate modern human populations, rather than populations drawn from geographic areas near the fossil locale.

In this paper, we extend this analysis of the ontogeny of robusticity to include all available European Early Upper Paleolithic (EUP) anatomically modern humans (AMHS), both juvenile and adult. The EUP AMHS track the warm adapted modern human sample, giving them an ontogenetic trajectory that is distinct from both cold adapted Neandertals and cold adapted modern human populations.

These results are in keeping with other analyses which have documented an overall ectomorphic body plan in the EUP AMHS which is at odds with the climate in which they lived. By placing these analyses in an ontogenetic context, we demonstrate that the adult EUP AMHS morph is achieved in a manner entirely consistent with other warm adapted modern humans. These results can be used to reflect upon the question of whether the EUP AMHS morph evolved *in situ* in Europe, or elsewhere.

New World branches, Old World roots: a craniofacial view of a North Asian homeland.

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Questions of American Indian biological origins have commanded increasing attention in the decades leading to the new millennium. Research presented over the past few years has indicated genetic ties between Asian and New World populations, suggesting North Asia (the Mongolia-Siberia-Manchuria region) as a probable Old World homeland for people migrating to the New World within the past 20,000 years. As well, statistical comparison of multivariate craniofacial data has begun to provide lines of evidence through the examination of human population expansions in Asia and the Pacific Basin, as well as the New World. This paper presents the results of analysis of craniofacial metric data recently collected in Mongolia representing the first part of a two year collaboration between Mongolian, American and Russian physical anthropologists. Euclidean and Mahalanobis distance statistics based on 24 craniofacial variables are used in a comparative evaluation of 3000 to 4000 individuals representing the New World, Pacific Basin, Asian Old World, Europe and Africa. These samples are selected from a database of nearly 8000 individuals worldwide with a time depth of 90,000 years. These results parallel the genetic findings and support the hypothesis of Mongolia and Manchuria as a likely Asian homeland. Newly collected material from Western Mongolia in the Russian Tuva region suggests ties to the American Plains Indians. A model for the peopling of the New World from diverse Asian Old World sources is reiterated, with some concluding comments regarding relevant population history in Central and Northern Asia.

The relationship of maturation length to interspecific variation in enamel hypoplasia. E.A. NEWELL, Elizabethtown College, Elizabethtown, PA 17022

While different durations of development have been offered as an explanation for intertooth variation in linear enamel hypoplasia (LEH) among non-human primates (Moggi-Cecchi et al., 1988; Moggi-Cecchi and Crovella, 1991; Skinner and Guatelli-Steinberg, 1997; Guatelli-Steinberg, 1998), the relationship between maturation length and enamel defects between species has not been examined.

This study investigates the association between LEH frequency and maturation in 101 taxa ($N=3520$). As a precise measure of maturation length is unavailable for most primates, two stages of dental development (age at eruption of M1 and age at completed eruption) are used as

indicators. In addition, size variables known to be highly correlated with maturation (male and female adult body mass, neonate body mass, adult brain mass and neonate brain mass) are used to examine this association across species.

Individuals are scored as having LEH if any one tooth in their permanent dentition exhibited a linear or groove defect. Only unworn or minimally worn teeth are included. Dental eruption ages, body and brain mass data are employed in least means square (model 1) regressions with LEH frequency.

Age at eruption of the first permanent tooth is highly correlated with frequency of linear enamel hypoplasia in 20 non-human primates ($r = .871$). The age at eruption of the last permanent tooth is also highly correlated with LEH frequency ($r = .802$). The relationship between maturation and hypoplasia is also supported by more indirect measures.

All analyses indicate that the variation in (LEH) frequencies among non-human primates is very closely related to variation in duration of maturation. The longer the period of maturation, the greater the potential risk of LEH formation.

Based on this association, a model is proposed to explain the formation of hypoplastic enamel defects across the primate order.

This research was supported by grants from the Department of Anthropology and the Graduate School of Temple University.

An expanded mtDNA phylogeny and its implications for gene flow and biogeography in baboons. T.K. NEWMAN, D.E. WILDMAN*, T. J. BERGMAN** and J. ROGERS, Dept. of Genetics, Southwest Foundation for Biomedical Research, San Antonio, TX 78245, *Dept. of Anthropology, New York University and NYCEP, NY, NY. 10003, **Dept. of Biology, Washington University, St. Louis, MO 63130.

A recent molecular phylogenetic analysis of baboon (*Papio hamadryas*) mtDNA sequences revealed 5 major clades. Chacma lineages are the sister group to all other subspecies, and guinea baboons are sister group to all olive, yellow and hamadryas lineages. The two hamadryas lineages observed are paraphyletic. The clade composed of all olives and yellows revealed little substructure and suggested a recent origin for this group. Here we present new results from a significantly expanded data set that includes >35 Arabian and Ethiopian hamadryas and Ethiopian anubis from multiple, known locations. The total sampling is >70 unique sequences. MtDNA sequences (900bp of ND4, ND5 and adjoining regions) were obtained either manually or using ABI sequencers, and analyzed using parsimony and distance methods. Inferred phylogenetic trees were used to test two hypotheses: 1) that the paraphyly of hamadryas lineages is due to recent gene flow/introgression

with Ethiopian olive baboons, and 2) the low nucleotide diversity observed in the olive/yellow clade is due to limited geographic sampling (i.e. only from southern Kenya). The new results indicate: 1) hamadryas lineages are still paraphyletic, suggesting that paraphyly in Ethiopia is unlikely to be explained entirely by recent gene flow and 2) the olive/yellow lineages still demonstrate low internal diversity, and thus seem to be of recent origin compared to other subspecies. These mtDNA phylogenies provide new insights into baboon biogeography and population history.

Skeletal and dental pathologies of aging in adult western lowland gorillas: a preliminary report. K.A. NICHOLS and A.L. ZIHLMAN

Five adult gorillas (N=5, Ave. age 35 years) with known life histories were analyzed for skeletal and dental pathologies associated with aging. Each individual showed evidence of gross bone or dental pathologies similar to those conditions of old age in human populations.

The results show several pathological conditions associated with advanced age: skeletal lesions (bony lipping and osteophyte formation) at major synovial and vertebral joints; extensive enamel wear (attrition) in both anterior and posterior dentition. Skeletal lesions were more common at hindlimb than at forelimb joints; vertebral skeletal lesions more frequently involved the lumbar-sacral region than the cervical or thoracic regions. Dental attrition was evident in nearly all of the teeth and ranged from small to extensive in size.

Comparison with studies on wild African apes (e.g., Jurmain, 1989; Lovell, 1987; Morbeck et al., 1991; Schultz, 1939, 1956, 1972) is instructive. Ages at death of wild individuals are usually only estimates, so that age related conditions are not fully known. Furthermore, trauma such as bone fracture is the most common skeletal pathology of wild apes and is less common in captive apes. This study assesses skeletal and dental pathologies of individuals of known ages where few pathologies are due to trauma. Comparison of pathologies of both wild and captive gorillas with those of chimpanzees suggests a gorilla pattern as well as continuity with skeletal and dental pathologies of geriatric humans associated with degeneration and senescence.

Marginal lipping relative to joint location, size, and function: a metric analysis of marginal osteophytes. S.E. Niebuhr, Department of Anthropology, Indiana University, Bloomington, IN 47405

Marginal osteophytes, bone extensions at the margins of joint surfaces, are a well-recognized indicator of joint

degeneration. Osteophytes are the result of endochondral calcification into relatively open spaces of the joint capsule. Paleopathologists generally score osteophytes as mild, moderate, or marked. While these categories are frequently subjective, in an occasional attempt at objectivity, categories have been defined metrically.

Size of osteophytes is limited, to some degree, by the amount of open space available. Thus joints with smaller capsules are expected to support smaller osteophytes. In addition, joint function influences type and degree of degeneration.

The current study is a metric analysis of osteophytes of two synovial joints – the non-weight-bearing elbow joint, and weight-bearing knee joint – and the cartilaginous intervertebral joints. The largest osteophytic growth of each joint surface – in the elbow, the trochlea and opposing surfaces of the proximal ulna; in the knee, the medial femoral and tibial condyles; and both centra of each intervertebral disc joint – are measured in fifty individuals from the Mississippian Schild cemeteries of west-central Illinois. Two comparisons are made within individuals – the various joint surfaces within each joint are compared to determine differences in arthritic expression of proximal and distal joint surfaces. Secondly, all joints of an individual are ranked according to osteophyte size, from smallest to largest.

Measuring every osteophyte in every individual is time consuming, and therefore not a useful method in the long run. This study helps to elucidate the meaning of osteophyte size, and therefore categorization. Caution is suggested in the use and interpretation of such categories. And always, in studies of joint disease, osteophytes should be considered in conjunction with other changes of the joint surface and capsule regions.

Morphological affinities of the Qafzeh 9 carpometacarpal articulations. W. A. NIEWOEHNER, University of New Mexico, Department of Anthropology, Albuquerque, NM 87131.

The Late Pleistocene hominid, Qafzeh 9, and most Neandertals are associated with Mousterian lithics, yet their hand remains differ in bony indicators of musculotendinous hypertrophy.

Neandertal carpal and metacarpal remains differ from recent human samples in both the shape and orientation of some of their carpometacarpal (CMC) articular facets, indicating not only adaptations to greater levels of joint reaction forces transmitted through the hands, but also to altered directions of principal joint reaction forces (e.g. Niewoehner et al., 1997).

The shape affinities of Qafzeh 9's CMC facets are assessed with a series of canonical discriminant functions performed on principal component (PC) scores of 3-dimensional landmark coordinates ($N = 60 - 85$) of the MC1, 3, and 5 bases, and the trapezium, capitate, and hamate metacarpal facets of Holocene human males and females ($N = 29 - 37$), Early ($N = 2 - 8$) and Late Upper

Paleolithic associated humans ($N = 5 - 8$), and Near Eastern and European Neandertals ($N = 6 - 10$).

3-dimensional landmark coordinates are acquired with photogrammetry of a 10x10 grid projected onto the articular surface. A Procrustes analysis, followed by PC analysis and visualization of the principal components of shape change are performed with the Morphogika software (O'Higgins and Jones, 1999). PC scores are analyzed with canonical discriminant functions. Qafzeh 9's affinities were determined by the classification criteria.

Qafzeh 9's MC1 and 3 bases and trapezium are most similar to Upper Paleolithic samples, its MC5 base and capitate resemble a Neandertal, while the hamate is most similar to the Holocene sample. The Upper Paleolithic samples are often morphologically transitional between the Neandertal and Holocene samples. Qafzeh 9 best fits the Upper Paleolithic morphological pattern.

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Meat-sharing among the marine foragers of Lamalera: an anthropometric test. D.A. NOLIN and M.S. ALVARD, Dept. of Anthropology, SUNY at Buffalo, NY 14261

Hypotheses derived from behavioral ecological theory make different predictions about the breadth of meat-sharing in foraging societies depending on local ecology. In general, kin selection predicts a relatively narrow distribution among close genetic kin. Reciprocal altruism suggests a broader distribution among reciprocating partners. Tolerated theft predicts an even broader, near-general distribution. This paper addresses the breadth of meat-sharing among one group of foragers, the sea hunters of Lamalera, through a novel application of anthropometric data.

Lamalera is located on the island of Lembata in the province of Nusa Tenggara Timur, Indonesia. The men of Lamalera hunt large prey including sperm whale (*Physeter catodon*) and several species of ray (*Manta birostris*, *Mobula kuhlii*, *Mobula diabolus*) from cooperatively constructed boats manned by 8 to 14 crew. The primary distribution of prey is to those who directly participate in the hunt and those who construct and maintain the hunting boat. The further distribution of these shares by the primary recipients to others is referred to as the secondary distribution.

The breadth of this secondary distribution is addressed using anthropometric data collected from October 1998 through August 1999 on Lamaleran children ranging in age from 0 to 18 years. Genealogical and residence data make it possible to relate individual children to primary recipients both genetically and spatially. Differences in growth between children are related to hypothetical secondary distribution patterns. Specifically, when secondary distribution of prey is general then there should be no appreciable differences in the growth rates of Lamaleran children with respect to kinship or residence. When secondary prey distribution is limited to close genetic kin

or close neighbors then children genetically or spatially closer to primary recipients should exhibit higher rates of growth. Results are discussed in relation to competing hypotheses regarding food sharing and the maintenance of a cooperative hunting subsistence strategy.

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Mapping genes for quantitative human traits. S.A. NOVAK, M. LEPPERT, J. MCCULLOUGH, Depts. of Human Genetics and Anthropology, University of Utah, Salt Lake City, UT 84112

The University of Utah Genetic Reference Project (UGRP) was implemented in 1997 with the objective of identifying genes for common human traits. This goal is being realized with the help of families that were recruited as participants in the human genome project. Three University of Utah researchers, Drs. Ray White, Mark Leppert and Jean-Marc Lalouel, identified forty-seven Utah families in the mid-1980s to serve as a reference set for the creation of genetic maps based on recurring DNA polymorphisms. These families consisted of three living generations with no less than 8 sibs in generation III and totaled 550 individuals. The extensive research based on this collection of DNA makes these 47 families the most intensively studied group anywhere. Investigators throughout the world have since used the maps created with these families' DNA to identify disease genes.

Initially, only genetic marker data were collected from these large families. Subsequently, physical and medical information to correlate with these genotypes is being gathered. Most recently we have begun collecting the standard IBP anthropometric data set from each family member included in the study. We here present our initial results on the first eleven families and compare them with NIH standards for the United States. We will also present limited craniofacial data that was collected using a rotating laser scanner to create a digitized image of the head and face. Some of these facial measurements have particular relevance to our interest in the genetic basis of the development of underlying facial morphology and how facial features change during human aging.

The UGRP's funding for the first years is being provided by the W.M. Keck Foundation of California.

Infectious disease in enslaved Africans of Colonial New York: descriptive indicators and the treponema question. C. NULL, University of Massachusetts Amherst, MA 01003, M.L. BLAKEY, S.H.H. CARRINGTON, Howard University, Washington, DC, 20059, K.J. SHUJAA, University of Pennsylvania, Philadelphia, PA, 19104, and F.L.C. JACKSON, University of Maryland, College Park, MD 20742.

New York's African Burial Ground is an 18th century cemetery for enslaved Africans, of which more than 400 skeletal remains have undergone extensive study. An interdisciplinary interpretation of types and

frequency of infectious disease, including treponemal diseases is made, here.

Percentages of individuals in the population exhibiting skeletal abnormalities indicative of response to an infectious agent were high regardless of age or sex. Furthermore, patterning of certain indicators (medial-lateral flattening, anterior-posterior bowing, and reactive bone of the tibia) suggests the presence of treponemal infection. Frequencies of this pattern are lower than in some 19th century studies and cranial lesions and post cranial cloaca associated with advanced syphilis were not present in the population.

The healing present in some of these individuals may allude to infection prior to arrival in colonial New York. We suspect that much of the evidence for treponematosi resulted from the tropical disease, yaws, rather than syphilis. Many individuals in this population were born in Africa or had spent a considerable period of time in the Caribbean. Historical documents often refer to yaws among African captives sent to New York, and rarely to syphilis. Economical value and the likelihood of importation was affected by observed treponematosi. The investigation of infectious disease affirms and further elaborates both the repercussions of enslavement, and may shed light on life before these Africans arrived in New York.

Allometric slopes and independent contrasts: a comparative test of Kleiber's law in primate ranging patterns. C. L. NUNN, Department of Biology, University of Virginia, Charlottesville, VA 22903 and R. A. BARTON, Department of Anthropology, University of Durham, 43 Old Elvet, Durham DH1 3HN, U.K.

At the most fundamental level, the size of an animal's home range is determined by its energy needs. In the absence of confounding variables, home range size should therefore scale with body size according to Kleiber's exponent for metabolic rate of 0.75. Comparative studies in a wide range of taxa have failed to confirm this prediction: home range size has commonly been found to scale with an exponent significantly greater than 0.75. We develop a comparative measure of metabolic needs that incorporates both mass-specific metabolic rates and social group size. We test the prediction that home range size in primates scales isometrically with this measure when an appropriate linear model is applied to data corrected for phylogenetic bias. Analyses using species values as data points indicate an exponent consistent with Kleiber's law. This results is misleading, however, because ecological factors confound the analysis, and the slopes within ecologically homogenous taxa are steeper. Accordingly, in analyses based on independent contrasts with reduced major axis, slopes are significantly greater than predicted by Kleiber's law. We examine the effects of other variables, and we find that systematic variation in substrate use and home range overlap best accounts for the discrepancy between Kleiber's law and the scaling of home range size. We therefore conclude that the scaling of home range size is subject to Kleiber's law, but in combination with other factors. This emphasizes that the study of allometry requires detailed attention to statistical models and control of confounding variables.

The influence of age and sex on dental microwear patterns in baboons living in the Awash National Park, Ethiopia. P. NYSTROM, Archaeology and Prehistory, University of Sheffield, Sheffield, U.K., J.E. PHILLIPS-CONROY, Anatomy and Neurobiology, Washington University Medical School, St. Louis, MO 63110, C.J. JOLLY, Anthropology, New York University, New York, NY 10003.

Dental microwear analysis has been used to reconstruct dietary habits of fossil primates, especially early hominids. Despite the wide interest and important applications of this method, there are still many unresolved methodological questions. All studies on extant species have found extensive intrapopulation variation in the pattern of dental microwear. Factors such as age and sex of the animals sampled, as well as seasonal variation in diet and other ecological factors, are thought to contribute to this variability. In the present study we examine how much of the intrapopulation variation in dental microwear features can be explained by sex and age. Dental impressions were collected from live wild caught baboons from the Awash anubis-hamadryas hybrid zone (*Papio hamadryas* sp.); 34 males and 22 females ranging in estimated age from 5 to 15+ years were sampled. Dental microwear features on facet 9 of the second maxillary left molar were examined using SEM. Feature density, feature type (round and linear features) and feature dimensions were examined. Preliminary statistical analyses failed to show a significant association between sex and feature density, type and size, although females tended to show higher feature density and greater variability in each feature examined. However, age was associated with total feature density: animals who were subadult or young adults had significantly more features than any of the other age categories, and the number of pit features contributed significantly to this value.

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The Broome County Poor House: Rates of Abscondance; Escaping from Charitable Organizations
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In other papers in this symposium we have argued that poor house of New York are windows to the biocultural aspects of burgeoning numbers of poor in this country during the nineteenth century. Absconding refers to the

practice of a criminal pauper leaving the guardianship of a poor house or farm without permission. New York pauper laws as practiced in Broome County allowed criminal paupers, those in debt, to be sold to the lowest bidder to work as an indentured servant. Another option for criminal paupers was to give their guardianship over to the superintendent of the poor house. The pauper had to agree to the rules and regulation of the Poor House that included not leaving the premises, restriction of visitors and censoring of mail. Infractions of the rules would lead to one being locked into a cell.

Abscondance is thus escaping from this humanitarian organization. We put forth the hypothesis that increased rates of abscondance might indicate deteriorating conditions in the poor house. Measures of this deterioration would be increasing population in the poor house and increasing numbers of deaths. Poor house records were analyzed in five ten-year periods from 1831 to the 1880. Unfortunately, the opposite trend appears to occur. Ten year averages show that the number of people absconding decreases over this fifty-year period. However, the number of people discharged, numbers received into the house, number in the house on December 1st and the number of deaths all increase during this period. During the 1860's abscondance is not reported. We suggest that the large increases in the population may have overwhelmed the system. We also suggest that it must have been increasingly difficult to consider one person criminally a pauper and another only temporarily a pauper, possibly effecting the records.

Human bone instruments from central Mexico during the Formative period. P. OCHOA, C. PIJOAN and J. MANSILLA, DAF-INAH, Reforma y Gandhi s/n, Mexico 11560.

Bone implements are an important part of the artifact equipment from very early times in Mexico. Numerous bone instruments from the Central part of Mexico have been found in several Formative sites (1200-200 b.c.); a great number of these have been identified as being from human's.

These artifacts had not been studied before as they were kept in the vaults of the National Museum of Anthropology in Mexico city. With the remodeling of the Preclassic Room almost all of them are going to be exhibited, so we had the opportunity to analyse them.

We consider that it is important to discern the manufacturing processes of these artifacts, as some are the oldest known from this part of Mexico. In these way we will be able in the future to determine the evolution of the techniques, as it seems that the use of human bones was continual in prehispanic Mexico.

Biotic and abiotic factors as predictors of species richness in Madagascar. P.M. O'CONNOR and N.J. STEVENS, Doctoral Program in Anatomical Sciences and Doctoral Program in Anthropological Sciences, SUNY at Stony Brook, Stony Brook, NY 11794.

Madagascar contains a great diversity of endemic forms. Over 53% of its birds, 90% of its known plant and invertebrate species, 95% of its reptiles, and nearly all of its freshwater fishes, amphibians, tenrec insectivores, cricetid rodents, carnivores and primates are unique to the island. Yet there exists great variability in the levels of species richness in isolated habitats scattered across the island.

A number of ecological factors have been advanced to account for patterns of species richness. In particular, abiotic factors such as habitat area, latitude, altitude, temperature and rainfall have been suggested to account for ultimate differences in species diversity. Biotic variables such as vegetational diversity have been suggested to be more proximate factors in determining the diversity of habitats available for animals to occupy.

This study addresses the importance of a number of these ecological variables for predicting species richness in Madagascar. Data on geography, topography, climate and vegetation are combined with species lists from over 25 national parks, reserves and other protected areas in Madagascar. Ecological variables are considered individually, and in combination in order to determine which biotic and abiotic factors serve as predictors of primate, mammal, and vertebrate species richness.

Results indicate that factors such as altitude range and phytogeographic diversity are good predictors of primate diversity, whereas other variables more commonly held to be associated with species richness, such as rainfall and habitat area, show a less clear relationship with overall primate, mammalian, and vertebrate diversity.

Long bone robusticity and claviculo-humeral proportions of the Amud 7 Neandertal baby. H. ODWAK, Anthropology, University College London, Gower Street, London WC1E 6BT

Two immature Neandertals (La Ferrassie 6, 3-5 years old, and Teshik-Tash 1, 8-10 years old) have been shown to have relatively thick femoral diaphyses and small medullary cavities compared to modern humans (Ruff *et al.*, 1994). Ruff and associates conclude that increased diaphyseal robusticity relative to modern humans was as characteristic of immature Neandertals as of adult pre-Recent humans. They hypothesize from this that immature Neandertals experienced a different developmental pattern, possibly as a result of increased mechanical loading of the skeleton which influenced diaphyseal modeling. In addition, high claviculo-humeral indices have been noted in immature

Neandertals (*e.g.* Dederiyah, 1.5-2 years old), perhaps indicative of increased trunk volume.

This study examines the developmental nature of these anatomical issues in the 9.5 month old Near Eastern Neandertal baby Amud 7. Claviculo-humeral proportions, and humeral and tibial robusticity were compared between Amud 7 and a prehistoric Native American immature skeletal sample derived from the Pacific Northwest Coast. Clavicular and humeral lengths, and bi-planar radiographs of the humerus and tibia were obtained from Amud 7 and the comparative samples. Percentage cortical and medullary areas were calculated for the 35%, 50% and 65% humeral diaphyseal levels, and for the 65% tibial level.

For the humeral and tibial diaphyseal levels examined Amud 7 is indistinguishable from modern human babies in percent and absolute cortical and medullary areas, either when scaled against dental age or respective long bone length. Overall, babies in the first year of life exhibit great variation in cortical and medullary areas. Amud 7's claviculo-humeral index (69.0) falls at the high end, but within, the modern human range for individuals under one year of age (range=62.2-71.1, mean=64.9, sd=3.5, n=5).

These results support the hypothesis that immature Neandertals do not differ from modern humans in diaphyseal robusticity prior to the developmental onset of significant mechanical loading. However, this research does suggest that Neandertals possess high claviculo-humeral indices shortly after birth and before the onset of significant mechanical loading. The ontogenetic implications of these results will be discussed.

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Changing Mobility Patterns in Incipient Farming Villages in the Tucson Basin. M. D. OGILVIE. Department of Anthropology, University of New Mexico, Albuquerque, NM 87131

One of the most important economic, social and biological transitions in human history is the transition from food collecting to food producing systems. Competing models regarding the interpretation of the archaeological evidence bring the economic organization of incipient Southwestern farmers into question. Were they committed agriculturalists occupying settled villages or seasonally mobile groups using agriculture as a buffer to wild resources? Reconstructing the changing economic strategies accompanying the first archaeologically detectable evidence of increased residential stability can be approached from a biological perspective.

Clinical research indicates a clear link between habitual physical activities and skeletal morphology. Cross-sectional data derived from computerized tomographic scans of femoral diaphyses provide a means to test hypotheses regarding relative mobility patterns at the cusp of the foraging to farming transition.

Study groups consist of residentially mobile foragers (n=42) from the Trans- and Lower Pecos regions of southwest Texas, early agriculturalists (n=21) from the Tucson Basin in southeastern Arizona, currently the earliest skeletal series found in association with domesticated maize

and sedentized agriculturalists (n=76) from the aggregated late prehistoric pueblo of Pottery Mound, New Mexico.

Two-way ANOVAs compared femoral cross-sectional property values for Ix/Iy, a proxy for *in-vivo* locomotor behavior, across sex and subsistence categories. Significant differences were seen for both sex ($p=0.011$) and subsistence ($p<0.001$). Results indicate that femoral robusticity significantly declined with increasing dependence on maize. While high mobility persisted in males at the advent of plant cultivation, females incorporated the sedentary tasks associated with early domestication into the domain of women's work.

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Advances in the analysis of form and pattern: facial growth and sexual dimorphism in *Cercocebus torquatus* and *Cebus apella*. P. O'HIGGINS, Evolutionary Anatomy Unit, University College London, WC1E 6JJ.

Oxnard's early studies of skeletal form in primates used what, were at that time, extraordinarily sophisticated multivariate morphometric methods. The variables commonly employed consisted of inter-landmark distances or ratios of such distances. One issue, however, is that of retaining information about full geometry in order to enable visualisations of patterns of variation in form. This has been addressed by recent methodological advances that take the configuration of landmarks itself as the basis for analysis and operate within a linearised tangent space to Kendall's shape space for Procrustes registered landmark data. These advances build on multivariate morphometric approaches and permit ready visual as well as statistical interpretation of results.

Oxnard was among the first to raise sexual dimorphism as an aspect of interspecific variation worthy of study. Not only is sexual dimorphism a confounding factor in the interpretation of variation amongst fossil remains but it is also an interesting biological phenomenon from the point of view of ecology, social organisation and ontogeny. A study is presented here which compares and contrasts the ontogeny of sexual dimorphism in two distantly related primate species; *Cercocebus torquatus* and *Cebus apella*. The study uses facial landmarks and applies geometric morphometric methods to examine ontogenetic changes in their configuration in males and females. It finds that, between these species, adult facial sexual dimorphism is very different. These differences between species are not the consequence of different ontogenetic mechanisms for the generation of dimorphism in each but rather of very similar mechanisms superimposed on very different ontogenetic trajectories. This study serves to indicate how the seeds sown by Oxnard's earliest work have grown to generate a powerful armoury of statistical tools for the 'mathematical dissection of anatomies' in the new century.

Further Dental Evidence on the Taxonomic Status of *Homo* Maxilla A.L. 666-1 (Hadar, Ethiopia). R. OHLINGER¹ and W.H. KIMBEL^{1,2}. ¹Dept. of Anthropology, Arizona State University, ²Institute of Human Origins, Arizona State University, Tempe, AZ 85287.

In 1994 a hominid maxilla, A.L. 666-1, was recovered from a 2.3 myr old artifact- and fossil-bearing horizon at Hadar, Ethiopia (Kimbel et al., 1996). Kimbel et al. (1997) designated the fossil *Homo* aff. *H. habilis*, potentially marking the earliest known occurrence of this species. We further investigated the taxonomic status of A.L. 666-1 using postcanine occlusal area and cusp proportions after the methods of Wood and Engleman (1988).

We measured the occlusal area of each cusp of the jaw's P³-M² on scanned photographic enlargements using SigmaScan v. 1.2 and compared these data with Wood's data (pers. comm.) for early *Homo* (n=5), *A. africanus* (n=11) and *A. robustus* (n=11). We found potential taxonomic variation only at P³. At 832 mm² the total P³ occlusal area for A.L. 666-1 falls near the upper end of the *H. habilis sensu stricto* range, while the Hadar specimen's relative buccal cusp size (53% of P³ occlusal area) approximates the mean for this species' hypodigm. However, the very large absolute (1080 mm²) and relative (64%) buccal cusp size of KNM-ER 1590 deviate strongly from those of other specimens traditionally lumped with it in a more broadly delimited *H. habilis*. The CV for the ratio "buccal cusp/total P³ occlusal area" in the pooled early *Homo* sample (9.8) is nearly twice that of *A. africanus* and *A. robustus*, due mostly to the inclusion of KNM-ER 1590. Although KNM-ER 1590 has by far the largest dentition overall of any early *Homo* specimen, relative buccal cusp size for P³ isn't expected to scale with positive allometry, as log-log regression shows an isometric increase in buccal cusp area with enlarging P³ occlusal area in both *Australopithecus* samples.

While sample sizes are limited and defy assessment of statistical significance, our results concur with other evidence that KNM-ER 1590 belongs to a species (= *H. rudolfensis*) distinct from *H. habilis*. They also reaffirm the assignment of A.L. 666-1 to a species identical, or very similar, to *H. habilis s.s.*

Skeletal variability and functional morphology. J.C. OHMAN, School of Biological & Earth Sciences, John Moores University, Liverpool, L3 3AF, U.K.; and C.O. LOVEJOY, Department of Anthropology and Biological Anthropology Program, Division of Biomedical Sciences, Kent State University, Kent, Ohio, 44242, U.S.A.; S.W. SIMPSON and B.L. LATIMER, Department of Anatomy, School of Medicine, Case Western Reserve University and Cleveland Museum of Natural History, Cleveland, Ohio, 44106, U.S.A.

Connective tissue cells are acutely sensitive to mechanical stimuli, and therefore figure prominently during bone and

cartilage modeling and bone repair. This has led to the presumption that behaviors which induce skeletal stress also induce morphological characteristics which are a simple reflection of those stresses. These include features such as relative bone robusticity and the relative reticulation of muscle attachments. This presumed cause and effect relationship is then regularly used to project mechanical stress during life (i.e., the cause) from relative bone robusticity/gracility (i.e., the effect). Unfortunately, this "approach" is far less straightforward than it is generally portrayed. The resolving power of frequently used measures such as cross-sectional geometric properties are highly problematic and are virtually untested. An even more fundamental question is the degree to which bony features actually do reflect differential behavior and permit its simple reconstruction.

The unique differences in upper limb loading in apes and humans provide an ideal test of these assumed relationships. Upper limb loading in wild-shot apes compared to that in obligatorily bipedal humans almost certainly generates different magnitudes and patterns of loading in their respective deltopectoral insertion complexes and humeri. Relative bone robusticity and deltoid reticulation should also covary with locomotor mode. We examined these variables in large samples of hominoids and found exceptional degrees of variability in deltoid expression. Arguably this variability should directly reflect comparable variability in the forces imposed upon the humerus during life. In fact, we find no regular relationship between relative deltoid tuberosity development and indicators of humeral strength, and no consistent association with locomotor pattern. We conclude that the complexities of connective tissue responses to loading are not yet sufficiently known to allow an accurate approximation of a bone's natural history.

Plant species for food, nesting material, and tools at a proposed chimpanzee refuge site in Caddo Parish, Louisiana. R.C. O'MALLEY, J.L. HORVATH, M. CROSWELL, and W.C. MCGREW, Miami University, Oxford OH 45056

There is a surplus of chimpanzees (*Pan troglodytes*) in research laboratories, where they are likely to be housed for the rest of their lives. A lower cost, effective alternative to laboratory housing is a large, outdoor enclosure in a warm climate. Before building such a facility with wooded enclosures, vegetation surveys are needed, since chimpanzees in nature use plants for food, nests and tools. Ideally, such use of vegetation for the benefit of the chimpanzees will have a minimal impact on the local flora and fauna. Chimp Haven, Inc., a non-profit organization, is developing a chimpanzee sanctuary in northwestern Louisiana. We did a vegetation survey there in order to inventory the species of plants and their abundance and distribution. Plant species with potential as food, nesting material and tools were identified and ranked by their relative abundance and utility. Five transects totaling 4.4km were done and 64 plant species were identified. Four transects were dominated by one species of conifer and four genera of hardwoods. The understory accounted for about three-quarters of the vegetation and included vines, shrubs, and saplings. The fifth transect was in a seasonal floodplain and lacked pines. It was dominated by mature,

broadleaf hardwoods, and the canopy (57%) was more abundant than the understory (43%). In the first four transects, 16 of the 24 most abundant genera have potential as food for chimpanzees, mostly in the form of leaves, stems, and bark. Three genera are used by great apes in captivity to build nests, and at least 10 other genera in these transects are useful raw materials for nest and tools. In the fifth transect, 11 of the 12 genera found are edible including large, fruiting trees; at least 7 genera in this transect are useful for nest building and tools. Many plant species present provide food for chimpanzees, and the dense understory may be sustainably harvested as browse for nests and tools.

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Lost and Found in the Museum: Repatriation, Ancestry, Ethnicity, and History. STEPHEN OUSLEY, DOUGLAS OWSLEY, and DAWN MULHERN, Department of Anthropology, Smithsonian Institution, Washington D.C. 20560

Establishing the cultural affiliation (i.e. ancestry) of human remains using biological data and other criteria is an essential part of NAGPRA and the NMAI act. Often, the decision whether or not to repatriate and to whom is based on biological data. Three examples illustrate the continuing need for biological assessments prior to repatriation.

According to Smithsonian records, one skeleton in the collections (SI 227508) was that of a "Sioux Giant" who was a member of a traveling circus and stood over 8 feet tall. The biological examination shows that the latter claims are very doubtful. First, discriminant function analyses of craniometrics from Whites and plains Indians born in the 19th century using measurements (92% accuracy) and shape variables (95% accuracy) classify him strongly as White (posterior probabilities = .96 and 1.0, respectively). Metric analysis of the postcranial remains also indicate that this individual is of European ancestry. Additionally, his teeth show much less wear than would be expected for his age. Second, the estimated stature using the Fully (1956) method is 79 inches. It is likely that this "Sioux Giant" was a white man who had assumed an Indian identity for dramatic effect as part of a circus.

The skeleton of a child (SI 243491) provides biological documentation for the historical fact that Native Americans kidnapped children from White frontier settlers and held them for ransom or raised them as their own. The remains were recorded as those of an (ethnically) Indian boy who had been caught stealing horses. Craniometric and nonmetric examinations indicate that the boy was of European ancestry. The documentation process also recorded the outcome of frontier justice: The cranium showed signs of perimortem blunt-force trauma.

From another museum, a cranium with a gunshot wound was excavated from a historic Native American site. It was assumed that the remains were Indian. Examination identifies the remains as those from a white male.

These examples illustrate the need for the evaluation of remains prior to repatriation, to ensure that the cultural affiliations in museum records are accurate.